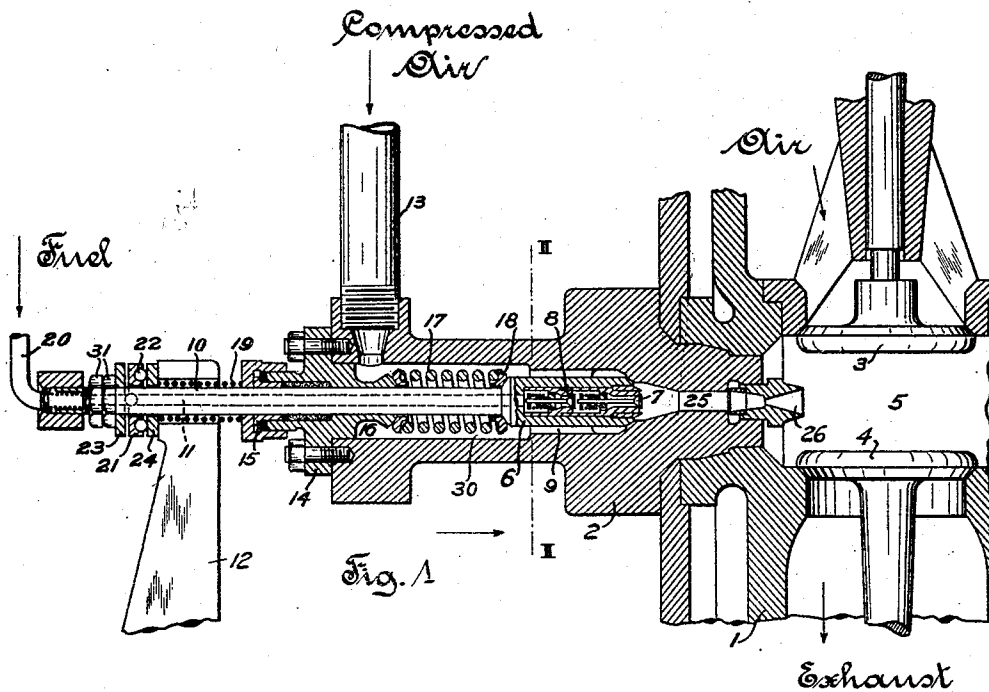
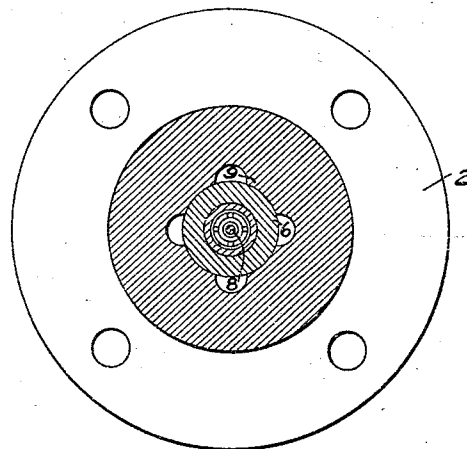


C. G. SPRADO.
INTERNAL COMBUSTION ENGINE.
APPLICATION FILED NOV. 4, 1916.

1,279,775.

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INTERNAL-COMBUSTION ENGINE.

1,279,775.

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To all whom it may concern:

Be it known that I, CARL G. SPRADO, a citizen of the United States, residing at Milwaukee, in the county of Milwaukee and State of Wisconsin, have invented a certain new and useful Improvement in Internal-Combustion Engines, of which the following is a specification.

This invention relates generally to improvements in the construction of internal combustion engines and relates more specifically to improvements in the construction and arrangement of the valves of such engines.

An object of the invention is to provide an internal combustion engine valve arrangement which is simple in construction and efficient in operation. Another object is to provide a compact and readily accessible arrangement of fuel inlet valves for internal combustion engines. A further object is to provide an efficient arrangement of fuel and injection-air ports. Still another object is to provide details of valve construction and of valve operating mechanism, which will reduce to a minimum the cost of construction and of maintenance.

The present invention consists primarily in providing two or more co-axial injection-air and fuel inlet valves, preferably located the one within the other. These valves are adapted to control the flow of fluids through concentric ports to a common mixing passage from which a mixture of the fluids is delivered to the engine.

A clear conception of an embodiment of the invention may be had by referring to the drawing accompanying and forming a part of this specification, in which like reference characters designate the same or similar parts in the various views.

Figure 1 is a transverse vertical section through the injection-air and fuel inlet valves of an internal combustion engine, showing the valves applied to a fragment of the engine cylinder.

Fig. 2 is an enlarged vertical section through the valves and valve casing, the section being taken along the line II—II of Fig. 1, looking in the direction of the arrow.

While the invention is disclosed as applied specifically to the injection-air and fuel inlet valves of an oil engine, it is to be under-

stood that it is not desired to limit the scope of the invention by such disclosure.

The fuel injection casing 2 is provided with a central through-passage and is fitted into a bore in the end of the engine cylinder 1. The cylinder 1 is provided with the usual inlet and exhaust valves 3, 4 through which air is delivered to and exhaust gases are discharged from the combustion chamber 5. Within the through-passage of the casing 2 is located an injection-air inlet valve 6 provided with a through-passage 11. The valve 6 is reciprocable within the through-passage of the casing 2 and controls a port connecting the annular chamber 30 with a mixing chamber or passage 25. The mixing passage 25 communicates with the combustion chamber 5 through an atomizing device or nozzle 26.

The oil inlet valve 7 is mounted adjacent the end of the through-passage 11 adjacent the cylinder end of the valve 6, this oil inlet valve being co-axial with the valve 6. The second oil inlet valve 8 is located entirely within and is mounted co-axial with the air inlet valve 6, the valve 8 being arranged closely adjacent the valve 7 in order to reduce to a minimum the space between these valves. The oil inlet valves 7, 8 are provided with suitable compression springs for maintaining them against their respective seats. The injection-air inlet valve 6 is provided with a stem 10 which engages a bore in the casing end head 14.

The outer extremity of the stem 10 is connected with an actuating arm 12 which is periodically moved to open the injection-air valve, in the usual manner. The joint between the end head 14 and the stem 10 is packed by means of an adjustable stuffing box 15.

The injection-air inlet valve 6 is normally urged against its seat within the through-passage of the casing 2, by means of a helical compression spring 17, one end of which engages an end surface of the head 14 and the opposite end of which engages an abutment surface formed on the valve 6. The ends of the spring 17 are provided with elements 18 having spherical zone surfaces which engage similarly formed surfaces of the adjacent structure. The valve 6 is guided by means of inwardly extending projections 9 which engage the outer cylindrical surface of the

enlarged end of the valve 6. A compressed air inlet pipe 13 communicates with the annular chamber 30 surrounding the valve 6, at a point adjacent the end head 14, the end head being formed with a projection extending longitudinally of the valve stem 10 and forming an annular chamber 16 from which the injection-air is delivered in the form of an annular jet into the portion of the chamber 30 surrounding the valve 6.

The extreme outer end of the valve stem 10 is connected directly to a fuel or oil inlet pipe 20, in any suitable manner, the connection being such as to permit reciprocation of the valve 6. A washer 23 surrounds the stem 10 and has its one face in engagement with a nut 31 screw-threaded upon the valve stem 10. The opposite face of the washer 23 engages a pair of ball bearings 22 which are fitted in sockets in the disk 21. The disk 21 is provided with a pair of sockets in the opposite side thereof, which lie in a plane at right angles with the plane of the first mentioned sockets. A pair of ball bearings 22 lying within the second mentioned sockets of the disk 21 engage one side of a second washer 24, the opposite side of which engages an end surface of the valve actuating arm 12. A helical compression spring 19, one end of which engages the stuffing box 15 and the opposite end of which engages an end surface of the washer 24, maintains coaction between washers 23, 24, the disk 21 and the ball bearings 22. This arrangement of washers, disk and ball bearings provides a universal connection between the arm 12 and the valve stem 10, which compensates for angularity of the arm 12.

During normal operation of the engine, fuel such as oil is delivered to the mixing chamber or passage 25 from the fuel inlet pipe 20 through the bore 11 and valves 7, 8. The fuel thus admitted to the mixing chamber 25 is urged through the atomizing nozzle 26 by means of compressed air admitted through the injection-air inlet valve 6. The delivery of fuel past the valves 7, 8 is automatically accomplished by means of a suitable pressure-producing means such as a pump, while the delivery of compressed air past the valve 6 is controlled by means of the valve actuating arm 12 which is manipulated in the usual manner by the valve gear. The details of the mechanism for moving the arm 12 form no part of the present invention and are well known to those skilled in the art.

It will be noted that by placing the fuel inlet valves 7, 8 within the injection-air inlet valve 6, a compact arrangement of valves results. This arrangement of the valves also permits concentric arrangement of the ports whereby the annular film of air delivered past the valve 6 tends to envelop the oil de-

livered through the valves 7, 8 and to thoroughly mix therewith. The location of the valve 7 beyond the seating of the valve 6 and within the chamber 25, and the arrangement of the mixing chamber 25 in direct communication with both the fuel and air valves 7, 6, provides a structure which is self-cleaning. By arranging the ports substantially in alinement with and in proximity to the atomizing nozzle 26, the mixture of oil and air is delivered directly to this device, resulting in more efficient atomization. The arrangement of valves concentrically of each other is especially desirable when locating these valves at the side of the engine cylinder, since in such arrangement the valve casing must ordinarily extend through the engine jacket and a compact arrangement of valves permits utilization of the jacket space to a maximum extent, for cooling purposes. The location of valves one within the other also permits ready removal of the valves for inspection. As the fuel inlet valves are ordinarily automatically actuated, while the injection-air inlet valve is mechanically actuated, it is more desirable to locate the former within the latter in order to avoid interference with efficient operation of the valves. By locating the valves 7, 8 closely adjacent one another and reducing to a minimum the volume of the space between these valves, danger of excessive heating of a relatively large quantity of oil due to a lodging of solids upon the seat of the valve 7 and consequent retention of this valve in open position, is avoided, since only the relatively small quantity of oil between the valves 7, 8 can be thus heated. The universal connection between the arm 12 and the valve stem 10 as well as the elements 18 between the spring 17 and the adjacent structure, insure proper alinement of the valve 6.

It is to be understood that it is not desired to be limited to the exact details of construction herein shown and described, for obvious modifications may occur to a person skilled in the art.

It is claimed and desired to be secured by Letters Patent:

1. In combination, an engine cylinder, means providing a mixing chamber in open communication with said cylinder, a valve for admitting fuel directly to said chamber, and a valve for admitting air to said chamber, one of said valves having a seating upon the other.

2. In combination, an engine cylinder, means providing a mixing chamber in open communication with said cylinder, a valve for admitting fuel directly to said chamber, and a valve for admitting air to said chamber independently of said fuel admission, one of said valves having a seating upon the other.

3. In combination, an engine cylinder, means providing a mixing chamber in open communication with said cylinder, a valve for admitting air directly to said chamber, and a valve for admitting fuel directly to said chamber, said fuel valve having a seating upon said air valve.

4. In combination, means providing a mixing chamber, an annular puppet air valve having a seating upon said means, and a valve for admitting fuel directly to said chamber through said annular air valve, said fuel valve having a seating upon said air valve.

5. In combination, means providing a cylindrical mixing chamber, a puppet injection air valve having a seating upon said means adjacent the wall of said cylindrical chamber, and a fuel valve having a seating upon said air valve in advance of said air valve seating.

6. In combination, an engine cylinder, means providing a mixing chamber in open communication with said cylinder, means for injecting liquid fuel directly into a medial portion of said chamber, and means for injecting air into said chamber around said fuel admission means and independently thereof.

7. In combination, an air valve, and a series of spaced fuel valves having seatings upon said air valve.

8. In combination, an air valve having a

central fuel passage, and a plurality of spaced valves for controlling the flow of fuel through said passage.

9. In combination, an air valve having a fuel passage therein, and a series of spaced valves for controlling the delivery of fuel from said passage.

10. In combination, an air valve having a central fuel opening therethrough, a valve for controlling the passage of fuel through said opening, and a second valve for controlling the delivery of fuel from an end of said opening.

11. In combination, an engine cylinder, means providing a mixing chamber in open communication with said cylinder, an automatically actuated valve for admitting fuel directly to said chamber, and a mechanically actuated valve for admitting air to said chamber, one of said valves having a seating upon the other.

12. In combination, an engine cylinder, means providing a mixing chamber in open communication with said cylinder, a mechanically actuated valve for admitting air directly to said chamber, an automatically actuated valve for admitting fuel directly to said chamber, said fuel valve having a seating upon said air valve, and means for periodically actuating said air valve.

In testimony whereof, the signature of the inventor is affixed hereto.

CARL G. SPRADO.